HK 8: Structure and Dynamics of Nuclei IV

Time: Monday 16:45–18:00 Location: HS 3 Physik

Group Report HK 8.1 Mon 16:45 HS 3 Physik

Constraining the density-dependence of the symmetry energy by cross section measurements at R^{3}B — •Lukas Ponnath for the R3B-Collaboration — TU Darmstadt, Darmstadt, Deutschland

The R^{3}B (Reactions with Relativistic Radioactive Beams) experiment, a flagship instrument of the NUSTAR collaboration at the GSI/FAIR facility in Darmstadt, is designed for kinematically complete reactions studies. Part of the R^{3}B physics program is to constrain the asymmetry term of the nuclear equation of state, improving our understanding of highly asymmetric nuclear matter, such as in neutron stars.

One approach to probe the density dependence of the symmetry energy near saturation density is the measurement of the neutron-skin thickness via total interaction or neutron-removal cross sections. These measurements allow for a direct comparison with reaction model predictions.

During the FAIR Phase-0 campaign, total interaction cross sections for ^{12}C+^{12}C collisions and charge-changing cross sections of tin isotopes were measured, serving as a stringent test of the reaction model. Building on this, the experiment was extended to $^{120\text{-}132}$Sn+^{12}C collisions at relativistic energies to study the total interaction and neutron-removal cross sections of neutron-rich systems.

In this talk, I will give an overview of the experimental campaign and present results from the finalized and ongoing analyses, including dipole polarizability studies as an additional observable.

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HK 8.2 Mon 17:15 HS 3 Physik

Search for near-threshold multi-neutron resonances in neutron-rich nuclei at R^{3}B — •Nikhil Mozumdar[1,2], Thomas Aumann[1,2,3], Antoine Barriere[4], Martina Feijoo-Fontan[5], and Olivier Sorlin[4] for the R3B-Collaboration — [1]Technische Universität Darmstadt — [2]Helmholtz Forschungsakademie Hessen fur FAIR — [3]GSI Helmholtz-Zentrum für Schwerionenforschung — [4]Grand Accélérateur National d'Ions Lourds — [5]Universidade de Santiago de Compostela

In order to constrain the largely unknown multi-neutron interactions, it is necessary to measure the relevant observables sensitive to them. One such property is the possible existence of narrow resonances related to multi-neutron cluster structures and correlations. This can be investigated by studying multi-neutron resonances close to the corresponding neutron removal thresholds in neutron-rich light nuclei. Toward this end, an experiment was performed in the state-of-the-art R^{3}B setup in GSI, within the FAIR Phase-0 program. Quasi-free scattering $(p, 2p)$ reactions are studied in inverse kinematics, where a radioactive ion "cocktail" beam is impinged on a 5 cm LH_2 target. The complete kinematic information of the resulting reactions is provided by the large combination of detectors in the setup. In this communication, we present a detailed study of the continuum structure of Boron isotopes, with an emphasis on the near-threshold states. This is followed by results of the two-body nn-relative energy distributions corresponding to these resonances. Supported by HFHF, the GSI-TU Darmstadt cooperation and the BMBF project 05P24RD1.

HK 8.3 Mon 17:30 HS 3 Physik

Expert experiments: data analysis, preview to upcoming experiments — •Martin Bajzek[1,2] and Ivan Mukha[1] for the Super-FRS Experiment-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [2]JLU Gießen, Gießen

In future experiments at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany, one of the experimental setups will be EXPERT at the Super-FRS separator. Super-FRS is a high-resolution magnetic spectrometer able to identify nuclei in a beam from hydrogen to uranium. EXPERT (EXotic Particle Emission and Radioactivity by Tracking) experiments explore the structure of unknown nuclei beyond the borders of proton and neutron driplines, including studies of reaction channels with proton/neutron resonances, beta-delayed decays, and in particular exotic 2p and 4p decays.

In this contribution, first results obtained from 2024 EXPERT experiment at the FRS with 9C secondary beam impinging on Be target will be presented.

HK 8.4 Mon 17:45 HS 3 Physik

Study of interaction and charge changing cross-sections of carbon and oxygen isotopes — •Rinku Prajapat for the BARB and Super-FRS Experiment-Collaboration — GSI, Darmstadt, Germany — SMU, Halifax, Canada

The development of radioactive beams and production techniques provide new insight into various dynamic and structural properties of unstable nuclei far from the stability line characterized by short half-lives and an unusual neutron-to-proton ratio. For instance, measurement of interaction (σ_I) and charge-changing (σ_{CC}) cross-sections are important for the deduction of the nuclear radii and also serve as an input in treatment planning programs for radiotherapy with heavy ions. However, the case of positron emitters (^{10,11}C and ^{15}O) is of special interest in ion beam therapy owing to their potential application in range verification via imaging using positron emission tomography (PET).

Thus, two experiments have been performed using the in-flight fragment separator and spectrometer FRS at GSI Darmstadt. The aim of the experiments was to measure the σ_I and σ_{CC} of ^{10,11,12}C and σ_{CC} of ^{15,16}O nuclei on a carbon, water, and $(CH_2)_n$ target at therapeutically relevant energies. The measurements were done using the transmission method, which means that the unreacted part of the beams is being analyzed. In this contribution, the experimental overview, data analysis, and preliminary results will be presented.

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